# Claims

1. A pixel for use in an image sensor, formed in a semiconductor substrate (A) processed on one side only, comprising:
an active area for converting incident radiation (In) into charge carriers of a first and a second charge type,
charge-separation means (FG1, FG2, …; FI1, FI2, …) located in said active area for separating said charge carriers of the first charge type from said charge carriers of the second charge type, and
charge-storage means (D, INT-Gate) for storing charge carriers of at least one charge type, said charge-storage means (D, INT-Gate) being located in a charge-storage area which is laterally adjacent to said active area, but geometrically separated and electrically isolated from said active area,
**characterized in that**
said charge-separation means comprise
at least one floating area (FG2, FG3, …; FI2, FI3, …) and at least two contact areas (FG1, FG7; FI1, FI7) provided with electric contacts (C1, C2) for applying a voltage (V2 - V1) to said at least two contact areas (FG1, FG7; FI1, FI7), said contact areas (FG1, FG7; FI1, FI7) being electrically isolated from said at least one floating area (FG2, FG3, …; FI2, FI3, …) yet electrically coupled

to at least one of said at least one floating area (FG2, FG3, …; FI2, FI3, …).

2. The pixel according to claim 1, wherein said charge-separation means comprise an arrangement of a plurality of floating areas (FG2, FG3, …; FI2, FI3, …), the arrangement being such that neighboring floating areas are electrically isolated from each other yet electrically coupled to each other.

3. The pixel according to any of the preceding claims, wherein said at least one floating area (FG2, FG3, …; FI2, FI3, …) and said at least two contact areas (FG1, FG7; FI1, FI7) have the same structure.

4. The pixel according to any of claims 1-3, wherein said at least one floating area is a floating photogate (FG2, FG3, …), said contact areas (FG1, FG7) being capacitively coupled to at least one of said at least one floating photogate (FG2, FG3, …), and, in case of a plurality of floating photogates (FG2, FG3, …), neighboring floating photogates being capacitively coupled to each other.

5. The pixel according to claim 4, wherein said photogates (FG2, FG3, …) and/or said contact areas (FG1, FG7) are made of polysilicon.

6. The pixel according to claim 4 or 5, wherein a buried channel (BC) is provided in said active area below said photogates (FG2, FG3, …) and said contact areas (FG1, FG7).

7. The pixel according to any of claims 1-3, wherein said at least one floating area is a floating implant (FI2, FI3, …), said contact areas (FI1, FI7) being coupled by the punch-through mechanism to at least one of said at least one floating implant (FI2, FI3, …), and, in case of a plurality of floating implants (FI2, FI3, …), neighboring floating implants being coupled by the punch-through mechanism to each other.

8. The pixel according to claim 7, wherein said substrate (A) is of a first doping type (p), a buried channel (BC) of a second doping type (n+) is provided in said active area, and said floating implants (FI2, FI3, …) and/or said contact areas (FI1, FI7) are of a third doping type (p+) and are arranged in said buried channel (BC).

9. The pixel according to any of the preceding claims, wherein said charge-storage means (D, INT-Gate) comprise a floating diffusion (D) or a floating gate (INT-Gate).

10. The pixel according to claim 9, wherein a readout node (D) is provided outside said active area, and an isolation gate (OUT-Gate) is arranged between said active area and said readout node (D) for electrically isolating said readout node (D) from said active area.

11. The pixel according to any of the preceding claims, wherein at least one coupling capacitor (EC) and/or at least one coupling resistor (ER) is provided for coupling two neighboring floating areas (FG2, FG3, …; FI2, FI3, …) and/or a contact area (FG1, FG7; FI1, FI7) to an adjacent floating area (FG2, FG6; FI2, FI6).

12. The pixel according to any of the preceding claims, further comprising an electric circuit for reading out said charge carriers stored by said charge-storage means (D, INT-Gate), the circuit being, e.g., a source-follower circuit, a charge-amplifier circuit or a transimpedance-amplifier circuit.

13. The pixel according to any of the preceding claims, comprising at least two distinct charge-storage areas.

14. An image sensor comprising a plurality of pixels arranged in a one- or two-dimensional array,

**characterized in that**

said pixels are pixels according to any of the preceding claims.

15. The image sensor according to claim 14, wherein the image sensor is of the complementary-metal-oxide-semiconductor, active-pixel-sensor or charged-coupled device type.

16. A method for sensing incident radiation (In), comprising the steps of:

converting the incident radiation (In) into charge carriers of a first and a second charge type in an active area of a semiconductor material (A) processed on one side only,

generating a lateral electric field at the semiconductor surface in said active area for separating said charge carriers of the first charge type from said charge carriers of the second charge type, and

storing charge carriers of at least one charge type in a charge-storage area which is laterally adjacent to said active area, but geometrically separated and electically isolated from said active area,

**characterized in that**

said lateral electric field is a steplike lateral electric field.

17. The method according to claim 16, wherein an arrangement of a plurality of floating areas (FG2, FG3, …; FI2, FI3, …) is provided in said active area, and
a voltage (V2 - V1) is applied to at least two contact areas (FG1, FG7; FI1, FI7) provided in said active area, thus generating said steplike lateral electric field, said contact areas (FG1, FG7; FI1, FI7) being electrically isolated from said at least one floating area (FG2, FG3, …; FI2, FI3, …) yet electrically coupled to at least one of said at least one floating area (FG2, FG3, …; FI2, FI3, …).

18. A method for sensing incident radiation (In) modulated with a modulation frequency, comprising the steps of:
converting the incident radiation (In) into charge carriers of a first and a second charge type in an active area of a semiconductor material (A) processed on one side only,
generating a lateral electric field at the semiconductor surface in said active area for separating said charge carriers of the first charge type from said charge carriers of the second charge type,
periodically changing said lateral electric field synchronously with the modulation frequency of the incident radiation (In), and
storing charge carriers of at least one charge type in at least two charge-storage areas which are laterally

adjacent to said active area, but geometrically separated and electically isolated from said active area,

**characterized in that**

said lateral electric field is a steplike lateral electric field.

19. The method according to claim 18, wherein

each period of the modulation frequency is divided into a number of intervals,

a separate charge-storage area is provided for each time interval, and

charge carriers are stored in the corresponding charge-storage area during each time interval.

20. The method according to claim 19, wherein the charge carriers stored in said charge-storage areas are read out, and demodulation parameters are calculated from said charge carriers.

21. The method according to claim 19 or 20, wherein charge carriers are stored in said charge-storage areas over more than one period of the modulation frequency.